

**GROUNDWATER
TECHNOLOGY, INC.**

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**CITY OF BARRE/MARCEL AVE
PHASE I INVESTIGATION**

NOVEMBER 26, 1991

PREPARED FOR:


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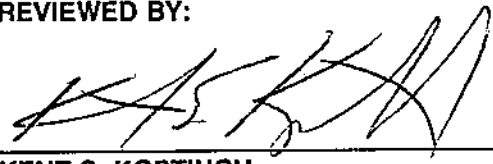
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TABLE OF CONTENTS

1.0 INTRODUCTION	1
2.0 SITE DESCRIPTION	2
3.0 SCOPE OF WORK	3
3.1 Background Research	3
3.2 Catch Basin Monitoring	3
3.3 Soil Vapor Study	4
3.4 Soil Extraction and Analysis	5
4.0 RESULTS	6
4.1 Background Research	6
4.2 Catch Basin Monitoring	7
4.3 Soil Vapor Study	8
4.4 Soil Extraction and Analysis	9
5.0 CONCLUSIONS	10
6.0 RECOMMENDATIONS	12

FIGURES

- FIGURE 1 SITE MAP
- FIGURE 2 PRELIMINARY SOIL VAPOR POINT LOCATION
- FIGURE 3 SOIL VAPOR AND SOIL EXTRACTION POINT LOCATION MAP

APPENDICES

APPENDIX A LABORATORY RESULTS

1.0 INTRODUCTION

On August 4, 1991 reports of a strong "fuel oil smell" emanating from culverts on Marcel Avenue, City of Barre, Vermont prompted preliminary investigation by the State of Vermont, Hazardous Materials Management Division to initiate confirmation of an apparent source of contamination. Chemical analysis of water obtained from culverts on Marcel Avenue on August 29, 1991 suggested this source to be proximate to the northeast end of Marcel Avenue. Figure 1 details the study area. At the suggestion of the State of Vermont, the City of Barre retained an environmental consultant to conduct a subsurface investigation to further define the source point of their contamination. On October 11, 1991 a geologist from Groundwater Technology, Inc. (Groundwater Technology) conducted a site walkover to assess possible strategies to confirm the source of the contaminant. A proposal to conduct a soil gas survey was submitted by Groundwater Technology to the City of Barre on October 16, 1991 and accepted on October 22, 1991. This report details the findings of the initial environmental assessment conducted from October 11, 1991 through November 15, 1991.

2.0 SITE DESCRIPTION

The study area encompasses a residential neighborhood located in a northeastern section of the City of Barre, Vermont. This initial investigation is centered on Marcel Avenue where known contamination exists in the storm sewer runoff system.

Site characteristics include a steep hilly topography with ground surfaces comprised of street asphalt and residential dwellings.

According to the geology for Environmental Planning in the Barre-Montpelier Region, Vermont, a report by the Vermont Geological Survey, completed in 1971, the study area overlies surficial materials consisting of unsaturated glacial till deposited directly from melting ice. These tills veneer the uplands with thicknesses generally ranging from 0 to 20 feet. They are generally impermeable and have a low yield water potential. Groundwater that might be encountered would be located in fractures of the metamorphic bedrock formation on which the glacial till rests.

3.0 SCOPE OF WORK

3.1 Background Research

Incorporated into the environmental assessment was the need to accumulate information relative to potential sources from which apparent fuel oil may have escaped. The goal of this research was to determine:

- The existence of any known or historical underground fuel storage tanks in the vicinity of Marcel Avenue in the overburden proximal to the known emanation of contaminants.
- Any possible fuel line failure servicing in home fuel oil tanks in the neighborhood.
- Any information which would indicate or aid in determining groundwater elevation and flow, or soil profile and porosity.
- The extent of contamination, or its range of downgradient effect and behavior.
- The existence of any additional underground pipe or preferential conduit by which liquid phase hydrocarbons may travel, not yet accounted for.
- Any known overland transport spills of fuel oil, or history of dumping such contaminants in the vicinity of the site.

3.2 Catch Basin Monitoring

On October 11, 1991, during an initial site walkover, and again on November 14, 1991, a photoionization detector was used to screen catch basins for volatile organic vapors. During each visit the rainwater catch basin outflow was also monitored in the same fashion. Groundwater Technology performed this monitoring to aid in defining more specifically an area of investigation.

Prior to Groundwater Technology's involvement in this investigation, water samples were obtained from storm sewers by the State of Vermont Hazardous Material Division. Review of the chemical analytical results on these water samples are addressed in brief.

3.3 Soil Vapor Study

Soil gas surveys are commonly used as a means to determine the lateral extent of soil and groundwater contamination by volatile organic chemicals (VOC's). VOC's, the major components of some petroleum based fuels, vaporize from the groundwater and move via diffusive and pressure transport through soil pore space. The relative concentration of VOC's in soil gas has been demonstrated to correlate well with dissolved hydrocarbons in underlying groundwater. Hence, by mapping soil gas concentrations, the position of underlying groundwater plumes can often be defined. Soil gas surveys also provide the investigator the advantage of a large number of data points that can be collected in a relatively short period of time.

Several factors influence the interpretation of soil gas survey data. These include the size, age and nature of the contaminant source, the moisture content of the unsaturated soil, and the volatility of the VOC's in the contaminant. Analyte detection of any particular vapor extraction point is a function of the interplay of these controlling factors.

For the Marcel Avenue site, a survey grid targeting suspected areas was established prior to field operations (Figure 2). This grid provided guidance for field placement of vapor extraction points. It was, however, subject to change based upon the results obtained as the survey progressed.

Prior to the day's field activities, all sampling equipment, drive rods, and soil probes were decontaminated by washing with Alconox solution and rinsing with distilled water. Sampling probes were further sanitized internally and externally using heat generated by a propane torch.

Soil gas samples were collected by creating a 5/8 inch diameter hole utilizing a drive rod to achieve a depth of four feet in the soil. Where pavement was present, an electric hammer drill was employed for penetration prior to using the drive rod. A 1/2 inch diameter, stainless steel probe was then placed in each vapor point. A sample of in-situ soil gas was then withdrawn through the probe utilizing a Gillian HFS-113a low flow vacuum air pump and used to purge ambient air from the sampling system. Once ambient air evacuation was complete, a 50 ml sample was withdrawn from the sampling loop. The vapor sample was then injected directly into a portable gas chromatograph for quantitative analysis of total volatile organic compounds (VOC's in parts per million by volume (ppmv)).

3.4 Soil Extraction and Analysis

To supplement the soil vapor study, field procedures were adjusted to aid in tracking possible VOC's directly beneath ground surface by obtaining and sampling soils. Utilizing the hammer drill, holes were bored to a depth of 20 inches below grade. Shavings were secured from the bottom 4 inches of each boring and placed in air tight 4 ounce soil jars. Samples were then taken to the mobil lab on-site and prepared for analysis by a portable gas chromatograph. An analysis was conducted on each sample which confirmed the presence or absence of petroleum hydrocarbons, but was deemed neither quantitative nor qualitative in nature.

4.0 RESULTS

4.1 Background Research

Upon the discovery of "fuel oil" vapors emanating from rainwater catch basins on Marcel Avenue, the City of Barre initiated interviewing many homeowners in the immediate neighborhood. Groundwater Technology contacted Mr. Dick Ather on November 11, 1991 to seek any helpful information which might aid in predetermining locations of SGS extraction points. Groundwater Technology was informed that all residents along Marcel Avenue, Veeder Avenue, and Snow Avenue were interviewed, in regard to fuel oil tanks. Also, Mr. Ather indicated all associated fuel oil dealers servicing the neighborhood were also contacted.

The results of these interviews, as conveyed to Groundwater Technology has not lead to specifically defining a source point of contamination. All fuel oil tanks servicing the neighborhood homes are internal of the homes, and the Engineering Department of the City of Barre has not located any underground fuel oil storage tanks.

Conversations with residents of the Marcel Avenue neighborhood, as conducted by Groundwater Technology has provided limited yet useful information:

- A number of springs have been discovered during excavation for foundations. Although these findings date back as much as 40 years, during the 1950's, when the neighborhood was first erected, it is suggestive that a perched aquifer may be contributing or influencing apparent migration of the contaminant.
- ?
Who 2?
Where Marcell
Regarding another excavation, a resident mentioned noticing two horizontal boreholes which were indicative of some type of former piping. These boreholes were described as 3 to 4 inches in diameter running parallel with each other, approximately 1 foot apart. These holes apparently extended beyond the owner's property and under the then unpaved Marcel Avenue at a 30 angle in an easterly direction. Again, this discovery was made some 40 years ago, however, the general direction of these horizontal conduits may be influencing contaminant transport. More investigation into these conduits may be necessary.
- Residences of the neighborhood also indicated that a farm was formerly located topographically upgradient of the Marcel neighborhood. Follow-up investigation by Dick Ather of the City of Barre confirmed the location of the farm to be upgradient of the neighborhood, although on the opposite side of Potash Brook. However, associated buildings of this same farm were formerly located above Cassie Street. This is topographically above the Marcel Avenue neighborhood, and east of the Potash Brook. More investigation will be required to confirm any possible source related to the old farm possibly once utilizing an underground storage tank.

- The influence of the contamination has been far reaching, and has apparently demonstrated a consistent potency despite varying environmental conditions. Interviews with residents affected by the fugitive contaminant indicate its effect has been as far reaching as Maple Grove, a street which borders Potash Brook, and is southwest of the Marcel neighborhood. This influence was greatest during hot summer months, specifically late July and August. A high degree of volatilization, as indicated by these observations, would suggest a more significant degree of contamination. Interviews with Marcel Avenue residents also suggest a greater vapor emanation from streets catch basins during or just after a period of rain. This information suggests the contamination is caught in the unsaturated and capillary zone of the soil profile just above the water table and is washed downward by rainfall percolation into groundwater flow.

4.2 Catch Basin Monitoring

Chemical analysis of water samples by EPA Method 8240 obtained from rainwater culverts along Marcel Avenue on August 29, 1991 by the State of Vermont Agency of Environmental Conservation indicated the presence of toluene and benzene in drain 1, and in a water sample obtained from the culvert outlet. Total volatile hydrocarbons detected in water samples of the culvert outfall were 2,790 parts per billion (ppb); and for samples obtained from culvert 1 were analyzed to be below detection limits. Catch basins 2 through 5 water samples were also analyzed and found to be below detection limits.

On October 11, 1991 and again on November 14, 1991, a photoionization detector was utilized to monitor ambient air in catch basins along Marcel Avenue as well as the culvert outfall. Results of this monitoring are found in Table 1. Catch basin locations are found on Figure 3.

On November 14 and 15, 1991, all catch basins on Marcel Avenue were observed to contain flowing water. It was noted that flow rates appeared consistent and of the same magnitude for all inlets except for CB-3 and CB-4. While CB-4 is offset from the main line and stagnant with regard to flow, CB-3 influent flow rate and volume appeared marginally greater than that observed of the next upgradient and in-line catch basin 5. This would suggest water (groundwater) recharge to the culvert system from sources other than surface runoff at an underground interception point somewhere between CB-5 and CB-3.

TABLE 1
AMBIENT AIR MONITORING OF
MARCEL AVENUE RAINWATER
CATCH BASIN

CATCH BASIN	OCT. 11, 1991	NOV. 14, 1991
Outfall	10 ppm	1.30 ppm
CB-1	100 ppm	4.00 ppm
CB-2	90 ppm	4.00 ppm
CB-3	85 ppm	20.00 ppm
CB-4	85 ppm	15.00 ppm
CB-5	75 ppm	12.30 ppm

ppm: parts per million

Photoionization detector: Thermal Environmental Instruments Mobile 580B

Calibrated: Daily with Isobutylene

4.3 Soil Vapor Study

On November 14 and 15, 1991, a total of 27 vapor points were analyzed for volatilized organic contents. Figure 3 shown the locations of these vapor points (VP1 - VP27). The first fourteen points were driven into Marcel Avenue on the south or outward side of the surface sewer to confirm a line of non contamination. All 14 points were successfully driven and analyzed to be below detection limits. The remaining 13 points were all driven on the north or inward side of the surface sewer line. Again, all points analyzed were below detection limits. See Appendix A for laboratory results by gas chromatograph analysis.

Vapor point 25 located on Snow Avenue, could not be analyzed as groundwater was encountered at three and one half feet when driving the point. A contaminant sheen was noted a-top the water which infiltrated the borehole for VP-25: this sheen reoccurred even after initial infiltration was bailed off.

4.4 Soil Extraction and Analysis

On November 15, 1991, seven boreholes were made to obtain soil samples for analysis to confirm the presence of petroleum hydrocarbons. Laboratory results of analysis by gas chromatograph are found in Appendix A. Sample points begin with SE 27 and continue through SE 33, see Figure 3.

5.0 CONCLUSIONS

Background research conducted by City of Barre and Groundwater Technology has determined the following:

- no known underground storage tanks exist in the vicinity of the Marcel Avenue study area;
- all residential in-home fuel oil tanks and supply lines are reportedly leak free;
- perched groundwater "springs" observed as have been seen by residents of the neighborhood during construction of many of the homes dating back approximately 40 years;
- the existence of the contamination as it has presented itself via odor emanation from catch basin and stream, was first discovered in late July of 1991. Varying environmental conditions such as dry hot days and during, or just after rainfall, have apparently increased the contaminant's volatilization and downgradient flow, respectively;
- associated buildings of a former farm are known to have existed topographically upgradient of the Marcel Avenue neighborhood and Potash Brook. Whether a source can be tied to this former site will require further investigation.

Catch basin monitoring through analysis of water samples obtained by the State of Vermont DEC suggest contaminant entry into the surface sewer system between catch basins 1 and 2.

Vapor monitoring of catch basin, 1 through 5 along Marcel Avenue on October 11, 1991 yielded the highest readings in CB-1 (100 ppm) and CB-2 (90 ppm). Results of a second vapor monitoring of catch basins showed the highest readings in CB-3 (20 ppm) and CB-4 (15 ppm).

A soil vapor study conducted on November 14 and 15, 1991, was not definitive in identifying a point-source in the lower Marcel Avenue area; all 27 points sampled were found to be below detection limits when analyzed for volatile organic contents.

A perched aquifer was discovered during the installation of soil vapor point VP-25. Water was encountered between 3 and 4 feet, and sheen was noted on top the water infiltrating the borehole even after subsequent bailings.

Soil samples obtained from points bored into Snow Avenue, and upgradient of the storm sewer system on Marcel Avenue, were analyzed and found to contain petroleum hydrocarbons.

A greater influent flow to catch basin 3 as observed at its underground influent port, suggesting groundwater influx to the storm system between CB-5 and CB-3 (CB-4 is offset to the main line of the system and was stagnant). A higher degree of odor and higher PID readings from CB-3 were also noted during field investigations conducted on November 14 and 15, 1991.

6.0 RECOMMENDATIONS

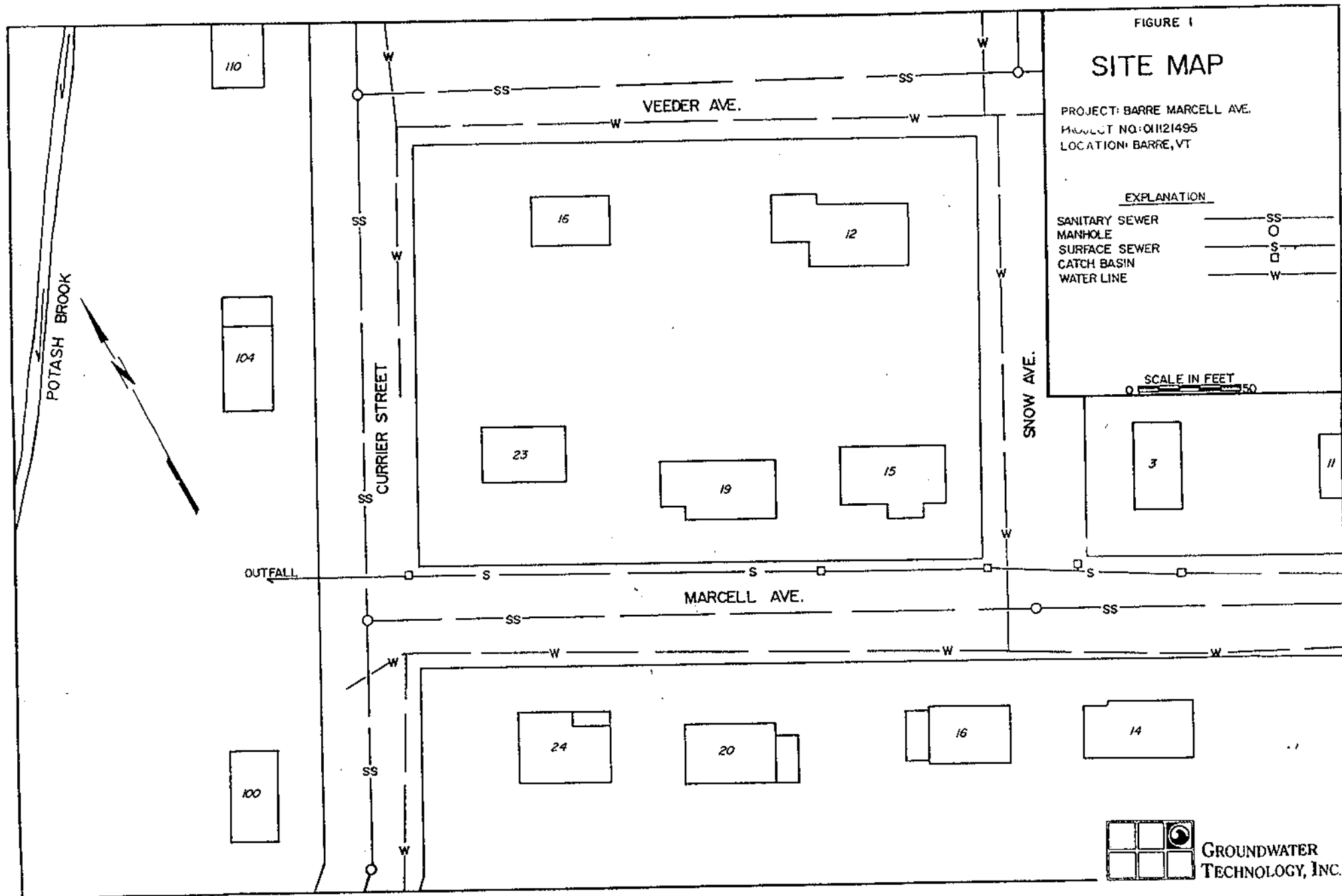
Information obtained through Investigative procedures suggest the contaminant to be entering the storm sewer runoff system between CB-3 and CB-4. In order to further substantiate these findings, a second phase investigation will be necessary. Objectives of which should include:

- definition of soil profile beneath study site to determine soil porosity and/or its ability to retain fuel oil;
- confirmation of depth to groundwater as well as groundwater flow and gradient; and
- chemical analytical analysis of soils and water to determine the degree of contamination.

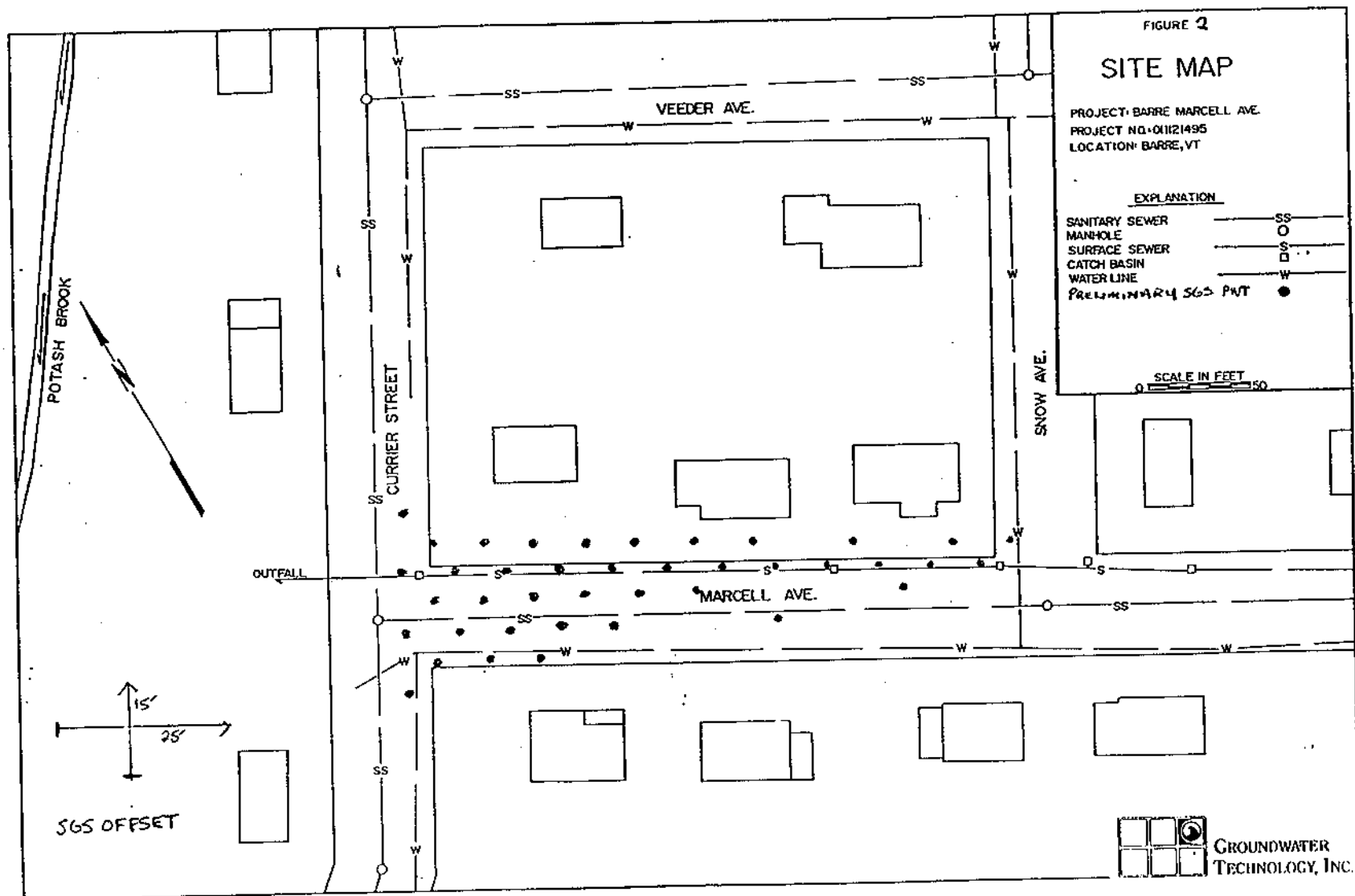
To accomplish these objectives, Groundwater Technology recommends:

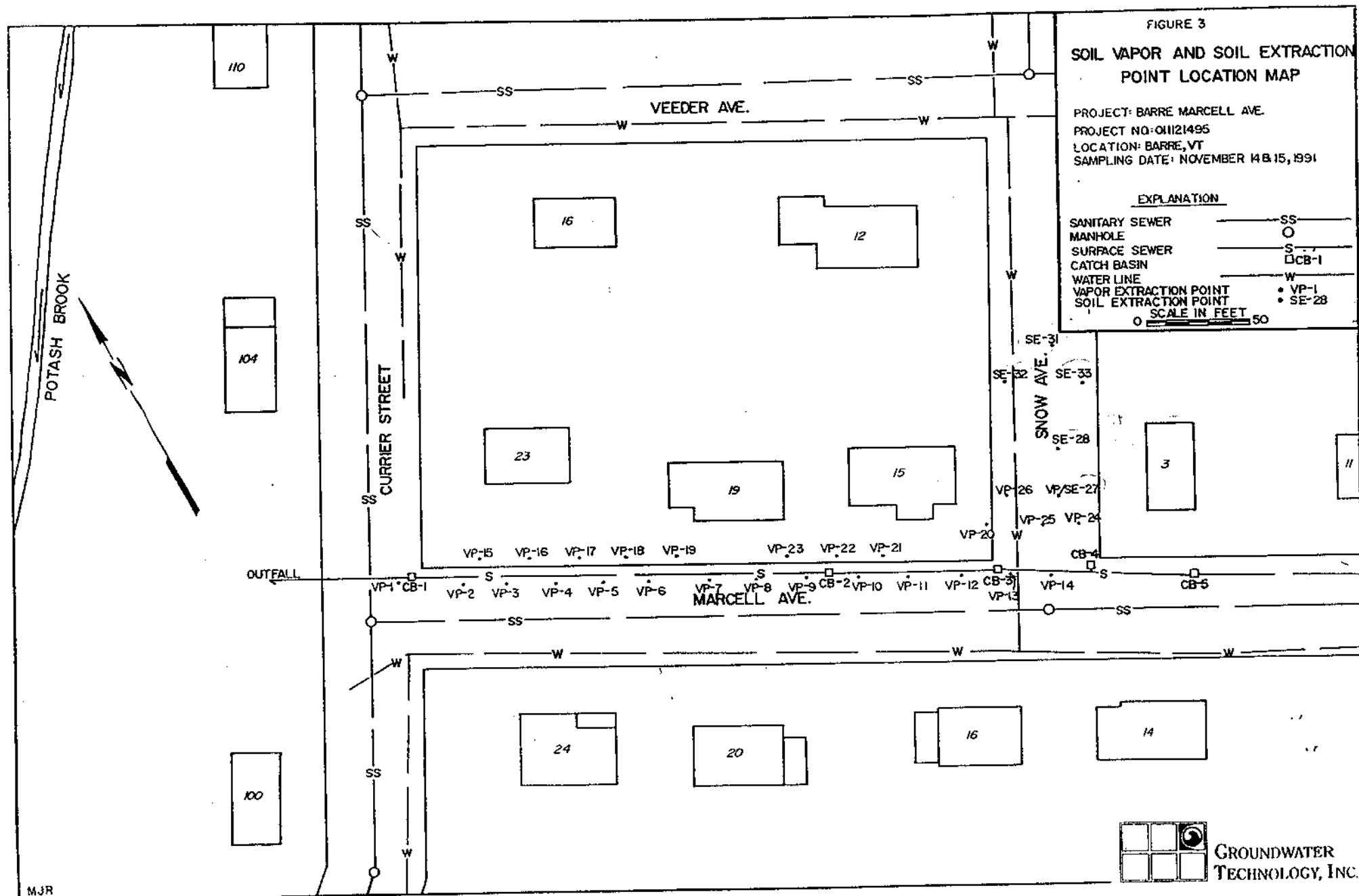
- the installation of up to 10 piezometers by means of hydropunch methodology. The piezometers installation should begin in the proximity of CB-3 with successive piezometers being placed in accordance with data obtained from the first.
- Soil profiling should be conducted during piezometer installation. Also, soils should be monitored by a photoionization detector for volatile organic content, with each installation.
- Upon reaching the groundwater, depth to groundwater measurements should be obtained to determine groundwater gradient and flow direction over the complete network of piezometers.
- On-site laboratory analysis of soils and water as deemed necessary to expedite source point location of the contaminant.

FIGURES



GROUNDWATER
TECHNOLOGY, INC.





APPENDIX A
LABORATORY RESULTS



GTEL

ENVIRONMENTAL
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Northeast Region

Meadowbrook Industrial Park
Milford, NH 03055
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(603) 673-8105 (FAX)

Client Number: 011121495
Project ID: Not Applicable
Work Order Number: N1-11-528

November 19, 1991

RECEIVED NOV 22 1991

Kent Koptiuch
Groundwater Technology, Inc.
32 Avenue C
Williston, VT 05495

Dear Mr. Koptiuch:

Enclosed please find the analytical results for the samples analyzed by GTEL's Field Services Group on 11/14/91-11/15/91.

The soil gas survey samples were analyzed with a Photovac 10S70 portable gas chromatograph utilizing a photoionization detector. Please refer to Appendix A for discussion of soil Total Petroleum Hydrocarbon (TPH) analysis.

If you have any questions regarding this analysis, or if we can be of further assistance, please call our Customer Service Representative.

Sincerely,

GTEL Environmental Laboratories, Inc.


Brian Wagner

Supervisor of Field Chemistry

Client Number: 011121495
Project ID: Not Applicable
Work Order Number: N1-11-528

ANALYTICAL RESULTS

Sample ID		VP-1	VP-2	VP-3	VP-4
Date Sampled		11/14/91	11/14/91	11/14/91	11/14/91
Date Analyzed		11/14/91	11/14/91	11/14/91	11/14/91
Depth of Sample		4'	4'	4'	4'
Analyte	Detection Limit, ppmv	Concentration, ppmv			
Total VOC	1.0	< 1.0	< 1.0	< 1.0	< 1.0
Detection Limit Multiplier		1	1	1	1

Client Number: 011121495
Project ID: Not Applicable
Work Order Number: N1-11-528

ANALYTICAL RESULTS

Sample ID		VP-5	VP-6	VP-7	VP-8
Date Sampled		11/14/91	11/14/91	11/14/91	11/14/91
Date Analyzed		11/14/91	11/14/91	11/14/91	11/14/91
Depth of Sample		4'	4'	4'	4'
Analyte	Detection Limit, ppmv	Concentration, ppmv			
Total VOC	1.0	< 1.0	< 1.0	< 1.0	< 1.0
Detection Limit Multiplier		1	1	1	1

Client Number: 011121495
Project ID: Not Applicable
Work Order Number: N1-11-528

ANALYTICAL RESULTS

Sample ID		VP-9	VP-10	VP-11	VP-12
Date Sampled		11/14/91	11/14/91	11/14/91	11/14/91
Date Analyzed		11/14/91	11/14/91	11/14/91	11/14/91
Depth of Sample		4'	4'	4'	4'
Analyte	Detection Limit, ppmv	Concentration, ppmv			
Total VOC	1.0	< 1.0	< 1.0	< 1.0	< 1.0
Detection Limit Multiplier		1	1	1	1

Client Number: 011121495
Project ID: Not Applicable
Work Order Number: N1-11-528

ANALYTICAL RESULTS

Sample ID		VP-13	VP-14	VP-15	VP-16
Date Sampled		11/14/91	11/14/91	11/14/91	11/14/91
Date Analyzed		11/14/91	11/14/91	11/14/91	11/14/91
Depth of Sample		4'	4'	4'	4'
Analyte	Detection Limit, ppmv	Concentration, ppmv			
Total VOC	1.0	< 1.0	< 1.0	< 1.0	< 1.0
Detection Limit Multiplier		1	1	1	1

Client Number: 011121495
Project ID: Not Applicable
Work Order Number: N1-11-528

ANALYTICAL RESULTS

Sample ID		VP-17	VP-18	VP-19	VP-20
Date Sampled		11/14/91	11/14/91	11/14/91	11/14/91
Date Analyzed		11/14/91	11/14/91	11/14/91	11/14/91
Depth of Sample		4'	4'	4'	4'
Analyte	Detection Limit, ppmv	Concentration, ppmv			
Total VOC	1.0	< 1.0	< 1.0	< 1.0	< 1.0
Detection Limit Multiplier		1	1	1	1

Client Number: 011121495
Project ID: Not Applicable
Work Order Number: N1-11-528

ANALYTICAL RESULTS

Sample ID		VP-21	VP-22	VP-23	VP-24
Date Sampled		11/14/91	11/14/91	11/14/91	11/14/91
Date Analyzed		11/14/91	11/14/91	11/14/91	11/14/91
Depth of Sample		4'	4'	4'	4'
Analyte	Detection Limit, ppmv	Concentration, ppmv			
Total VOC	1.0	< 1.0	< 1.0	< 1.0	< 1.0
Detection Limit Multiplier		1	1	1	1

Client Number: 011121495
 Project ID: Not Applicable
 Work Order Number: N1-11-528

ANALYTICAL RESULTS

Sample ID		VP-25	VP-26	--	--
Date Sampled		11/14/91	11/14/91	--	--
Date Analyzed		11/14/91	11/14/91	--	--
Depth of Sample		4'	4'	--	--
Analyte	Detection Limit, ppmv	Concentration, ppmv			
Total VOC	1.0	< 1.0	< 1.0	--	--
Detection Limit Multiplier		1	1	--	--

APPENDIX A

Due to the lack of positive soil gas survey data, seven proposed soil gas points were analyzed for Total Petroleum Hydrocarbons (TPH) by gas chromatography (GC).

The samples were obtained from dull cuttings associated with drilling pilot holes for the soil gas points. The samples were screened for presence or absence of petroleum hydrocarbons. S-27, 28, 30, 31, 32 and 33 showed presence of petroleum hydrocarbons while S-29 did not. The samples were collected in 4-ounce widemouth jars and subsampled into a 40 mL VOA vial. Anhydrous sodium sulfate was added to the soil to remove any water present. The sample was then extracted with 10 mL of capillary grade methanol, shaken vigorously and allowed to settle. One microliter of the methanol extract was direct injected into an SRI 8610 portable gas chromatograph with photoionization and flame ionization detectors in series.

The gas chromatograph is temperature programmable and fully computer driven.